Gregory Wetland and Stream Restoration As-Built Report Halifax County, NC

#114

Prepared For:

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EXECUTIVE SUMMARY

This report is submitted to document completion of construction and planting on the Gregory wetland and stream restoration project. This report will also serve as a baseline for future monitoring reports submitted pursuant to the requirements set forth in the Gregory Site Stream and Wetland Restoration Plan.

The Gregory wetland and stream restoration site is located near the town of Halifax in Halifax County, North Carolina. The project is located entirely within the Tar-Pamlico River Basin. Ditches on the site were used to promote drainage when the land was under agricultural production. The objective of the project was to restore approximately 6,725 feet of stream channel and a minimum of 75 acres of prior-converted wetlands. The restoration involved the filling of drainage ditches and topographic manipulation to raise the local water table and restore the site hydrology. Surface water flow was routed from an existing drainage ditch to a new meandering channel constructed across the abandoned floodplain. The abandoned ditch was then filled. Several structures were installed to control streambed grade, reduce stresses on streambanks, and promote bedform sequences for increased habitat diversity. The design allows for flows larger than the bankfull flow to spread onto the floodplain, dissipating flow energies and reducing the stress on streambanks. Streambanks were stabilized using a combination of erosion matting, live staking, and transplants. Bare-root stems of eight tree species appropriate for small stream swamp ecosystems were planted at an average density of 695 stems per acre.

All grading activities and restoration practices were completed in January 2005. Planting of bare-root trees was also completed in January 2005. Installation of post-restoration monitoring wells on the site was completed in late January 2005. A total of 85.8 acres of wetland and 6,757 feet of stream channel were restored. Initial site observations and well data indicate that the site is performing well as a stream and wetland system.

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Photo P3. A log weir at the beginning of Reach 1.

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INTRODUCTION

The Gregory wetland and stream restoration site is located near the town of Halifax in Halifax County, North Carolina (see Figure 1). The site has a past history of agricultural use consisting primarily of row crop agriculture. Ditches on the site were used to increase subsurface drainage when the land was under agricultural production.

Restoration of the Gregory site involved the restoration of a "small stream swamp" with associated "bottomland hardwood" and "cypress swamp" communities as described by Schafale and Weakley (1990). Restoration of the site involved the restoration of one stable meandering channel across the hydric farm fields on the site. The channel was designed and constructed using natural channel design techniques. Restoration also involved raising the local water table by filling the drainage ditches on-site and scarification of the fields and breaking of the local plow pan to provide increased surface storage of water.

The history of the project is summarized in Table 1.

Table 1. Project History

May 2004	Reference monitoring wells installed
June 2004	Approved Restoration Plan
October 2004	Construction began
January 2005	Construction completed
January 2005	Planting completed
January 2005	Post-construction monitoring wells installed
November 2005 (scheduled)	First monitoring report

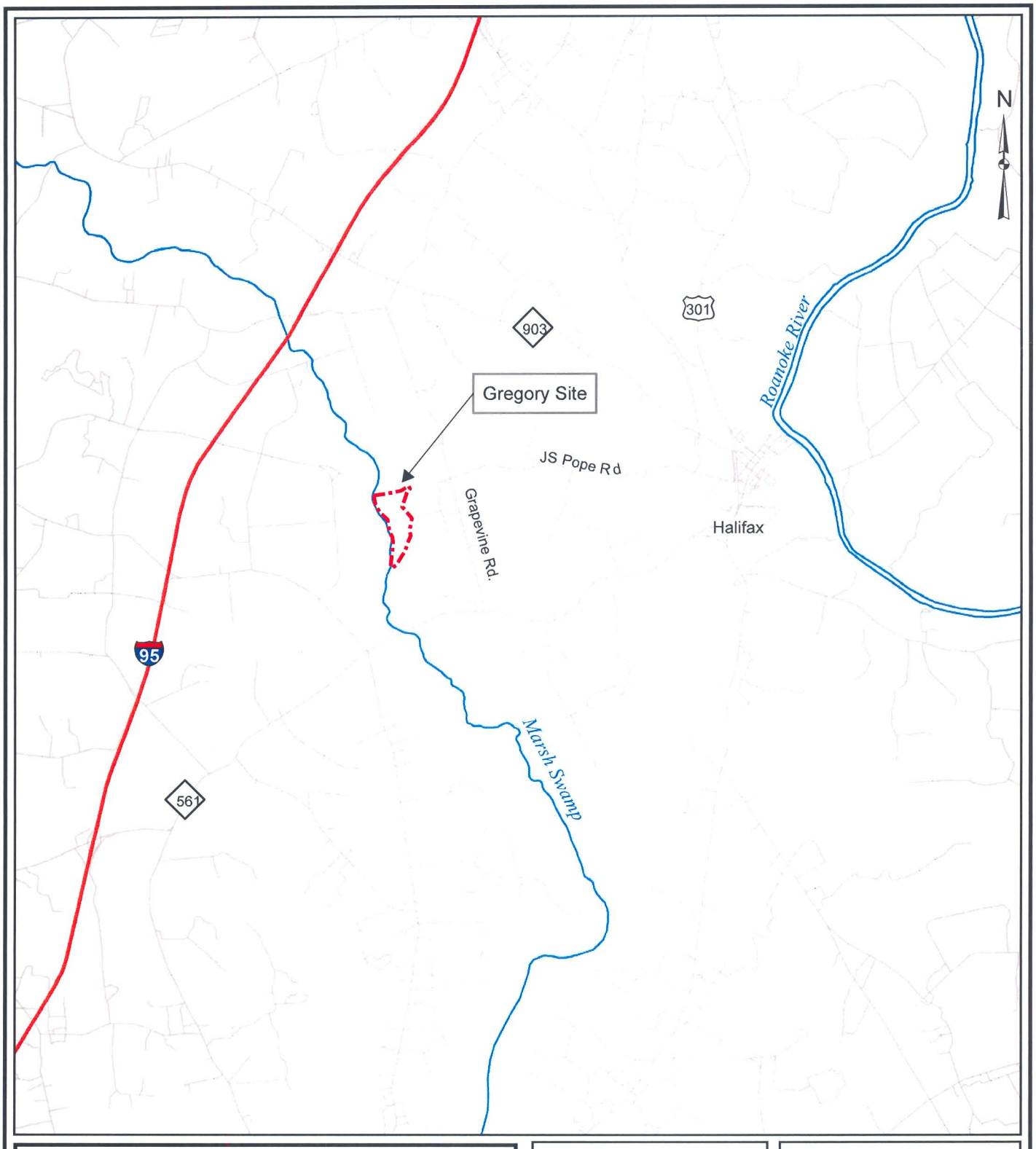
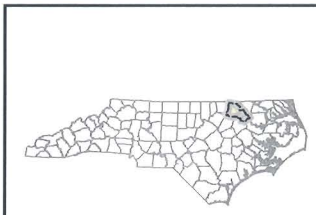
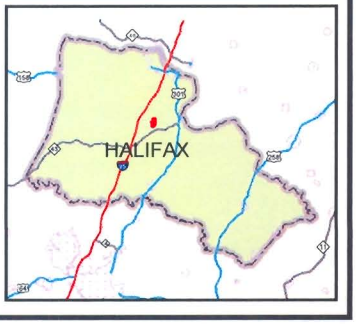


Figure 1. Project Vicinity Map

EBX Neuse-I, LLC
220 Chatham Business Drive
Pittsboro, NC 27312

1 0.5 0 1 2 Miles





AS-BUILT REPORT

Construction

Construction activities, in accordance with the approved Restoration Plan for the site, began in October 2004 with construction stakeout, followed immediately by the establishment of access sites and stockpile areas. Materials were stockpiled as needed for the initial stages of construction.

The next step was the grading of the floodplain areas to reach design grades across the site. The excavated material was stockpiled in specified areas near field ditches that were to be filled. Where necessary, silt fencing was installed between stockpiles and the active ditches to prevent erosion of sediment into the channel. A berm was also constructed along the western bank of McCulloch's Ditch to provide access to the site and keep floodwaters onsite and off adjacent farmland.

Once the design floodplain grades were achieved, a new stream channel was sculpted and constructed. Construction of the new stream channel for Reach 1 began near station 10+62 and proceeded downstream. McCulloch's Ditch was plugged on both sides of Reach 2, where the new channel crossed the existing McCulloch's alignment. Upon completion of new channel segments, in-stream structures, matting, and transplants were installed, and the channel was prepared to accept flow from the old channel. Once fully prepared, temporary sediment traps at the downstream ends of the channels were removed, and water was turned into the newly constructed channel. Abandoned field ditches were immediately filled and graded.

The site was not disked for two reasons: disking equipment could not be pulled across the site due to muddy conditions, and it was determined that disking was not necessary for the purpose of increasing surface storage. Upon completion of earthmoving activities in each construction area, temporary and permanent seeding was applied according to the plans and specifications.

Vegetation

Earthmoving activities were completed in early January 2005. Live staking of the streambank areas and the spreading of the permanent seed mixture was completed in late January 2005, along with the planting of bare-root trees. The approved Restoration Plan for the Gregory site called for the planting of eight (8) bare-root tree species, which were planted as listed in Table 2 below. Based on information collected from sampling plots (data provided in Monitoring section), the average density of planted stems across the site was approximately 695 stems per acre.

Table 2. Tree Species Planted over the Gregory Restoration Site

Species Planted	
Willow oak	*Quercus phellos*
Swamp chestnut oak	*Quercus michauxii*
Laurel oak	*Quercus laurifolia*
Overcup oak	*Quercus lyrata*
Blackgum	*Nyssa sylvatica*
Swamp blackgum	*Nyssa biflora*
Green ash	*Fraxinus pennsylvanica*
Bald cypress	*Taxodium distichum*

General Observations

Despite extremely wet conditions, construction on the site proceeded with very few problems or changes to the proposed Restoration Plan.

Modifications made during construction involved the location and selection of in-stream structures and bank stabilization practices. Substitutions were made based on availability of materials and professional judgment. These changes are documented in the attached as-built drawings.

Several rainfall events occurred during construction, but the rainfall amounts and intensities were not large enough to cause significant erosion or problems with construction. The final as-built stream length for the project, as indicated on Sheet 1, was 6,757 feet, as compared to the 6,725 feet predicted in the Restoration Plan.

Based on early observations, the hydrology of the site has been altered to a much wetter regime than was present prior to construction. Ponding in isolated pockets on the site has been observed for extended periods after rainfall events.

Early observations also indicate that the vegetation treatments were effective at establishing ground cover quickly. Temporary seeding (rye grain) applied to streambanks beneath the erosion matting sprouted within two weeks of application and has provided good ground coverage. Live stakes and planted bare-root trees were beginning to bud when the growing season began.

The Restoration Plan predicted that approximately 75 acres of restoration were available on the site. Initial site indications during construction indicate that this area is greater. Figure 2 and Plan Sheets 10 and 11 show the revised wetland restoration acreage at 85.8 acres. Based on visual observations and preliminary well data, filling the drainage

ditches that once drained groundwater from the proposed restoration areas has caused the local water table to rise. The revised acreage will be confirmed through the monitoring process based on groundwater monitoring data.

MONITORING

The five-year monitoring plan for the Gregory restoration site includes criteria to evaluate the success of both the wetland and the stream components of the project. The specific locations of vegetation plots, monitoring wells, photo points, permanent cross sections, and rainfall and crest gauges are shown on the as-built drawings in Sheets 4 through 11.

Consistent with the Gregory site-specific Restoration Plan, seven vegetation plots (wetland plots are 0.05 acre and the stream plots are each 0.1 acre in size), seven automated monitoring wells, and four manual monitoring wells were established in areas that would represent a range of hydrologic conditions and community types across the restoration site.

The initial planted density within each of the seven vegetation monitoring plots is given in Table 3. The locations of the vegetation plots and the monitoring wells are shown on the as-built plan sheets.

Table 3. Initial Planted Density of Trees for the Eight Vegetation Sampling Plots

Sampling Plot No.	Counted Stems per Plot	Stems per Acre (extrapolated)
1	41	774
2	37	698
3	42	792
4	39	736
5	66	660
6	56	560
7	65	650

For monitoring stream success criteria, fourteen permanent cross sections and two crest gauges were installed. The permanent cross sections will be used to monitor channel dimension and bank erosion over time. The two crest gauges, one in each stream reach, will be used to document bankfull events. In addition, a complete longitudinal survey was completed for the restored stream channel after construction to provide a baseline for evaluating changes in bed conditions over time. The longitudinal profile included the elevations of all grade control structures. Permanent cross sections were also surveyed after construction to provide baseline data for monitoring. The longitudinal and permanent cross section data are provided in Appendix 2. The locations of the permanent cross sections and the crest gages are shown on the as-built plan sheets.

Monitoring success criteria applied to the Gregory site are provided in the site-specific Restoration Plan. Monitoring data will be provided in the monitoring report for Year 1.

REFERENCE

Schafale, M.P. and A.S. Weakley. 1990. *Classification of the Natural Communities of North Carolina, Third Approximation.* North Carolina Natural Heritage Program, Division of Parks and Recreation, NCDEHNR. Raleigh, North Carolina.

APPENDIX 1
PHOTOGRAPHS OF THE PROJECT SITE

PRECONSTRUCTION PHOTOGRAPHS

Photo PC1. Restoration area before construction activities began.

Photo PC2. Lateral field ditches before construction activities.

CONSTRUCTION PHOTOGRAPHS

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COMPLETED PROJECT PHOTOGRAPHS

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Photo P5. Middle portion of the project. Scarification and minor grading resulted in a diversity of hydrologic wetland conditions.

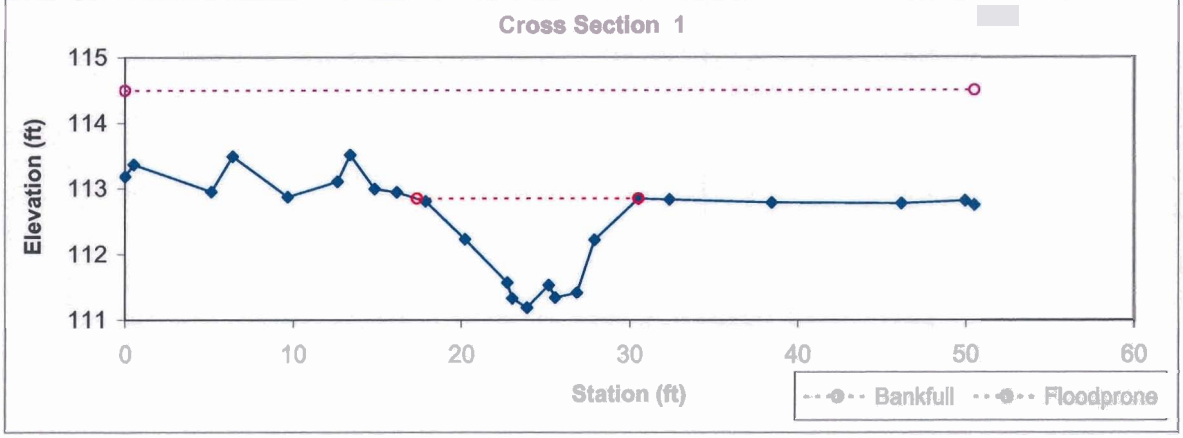
Photo P6. An area in the middle of the project after planting was completed.

APPENDIX 2
AS-BUILT LONGITUDINAL PROFILE AND PERMANENT CROSS SECTION DATA

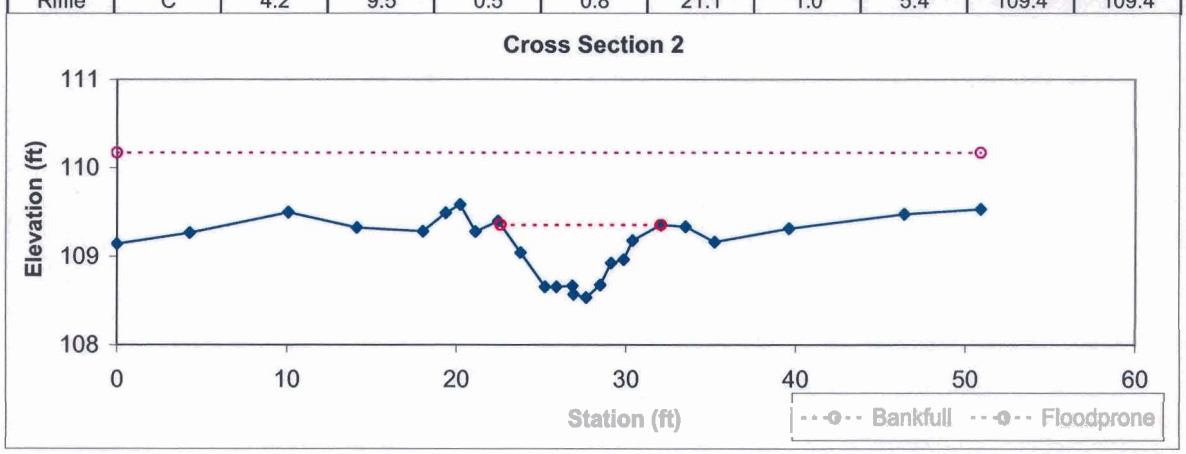
Summary of Cross-section Data: Gregory As-Built Cross Sections

Cross-section Descriptor	X1	X2	X3	X4	X5	X6	X7	X8	X9	X-10	X-11	X-13	X-14
Feature	Riffle	Riffle	Pool	Riffle	Pool	Pool	Riffle	Pool	Riffle	Riffle	Pool	Riffle	Pool
Rosgen Stream Type	C	C		C			C		C	C		C	
Bankfull Width (ft)	13.2	9.5	13.0	9.1	10.3	12.1	12.1	9.3	5.2	10.9	4.2	11.0	15.4
Bankfull Mean Depth (ft)	0.9	0.5	1.1	0.6	1.2	0.9	0.8	1.6	0.3	0.6	1.3	0.4	1.1
Width/Depth Ratio	15.5	21.1	12.3	16.6	8.3	13.3	15.9	5.6	15.1	18.9	3.3	27.5	14.2
Bankfull Area (sq ft)	11.2	4.3	13.7	5.0	12.7	11.1	9.2	15.2	1.8	6.3	5.4	4.4	16.8
Bankfull Max Depth (ft)	1.7	0.8	2.2	1.0	2.2	1.8	1.3	2.8	0.5	1.3	2.7	0.9	2.3
Width of Floodprone Area (ft)	50.5	50.9	56.1	50.4	77.0	73.6	54.0	60.6	48.4	55.3	31.5	79.3	100.2
Entrenchment Ratio	3.8	5.4	4.3	5.6	7.5	6.1	4.5	6.5	9.3	5.1	7.5	7.2	6.5
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

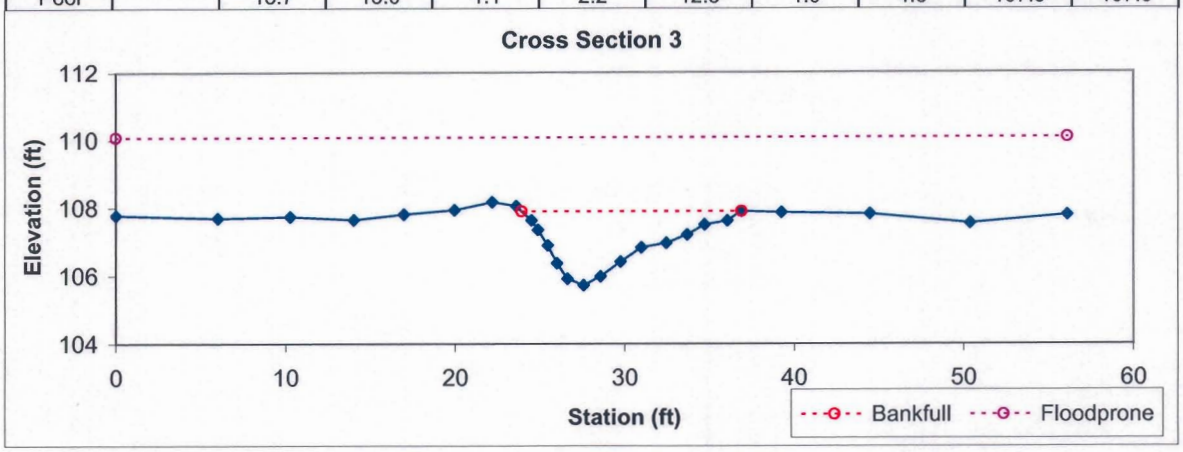
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	11.2	13.2	0.9	1.7	15.5	1.0	3.8	112.9	112.9



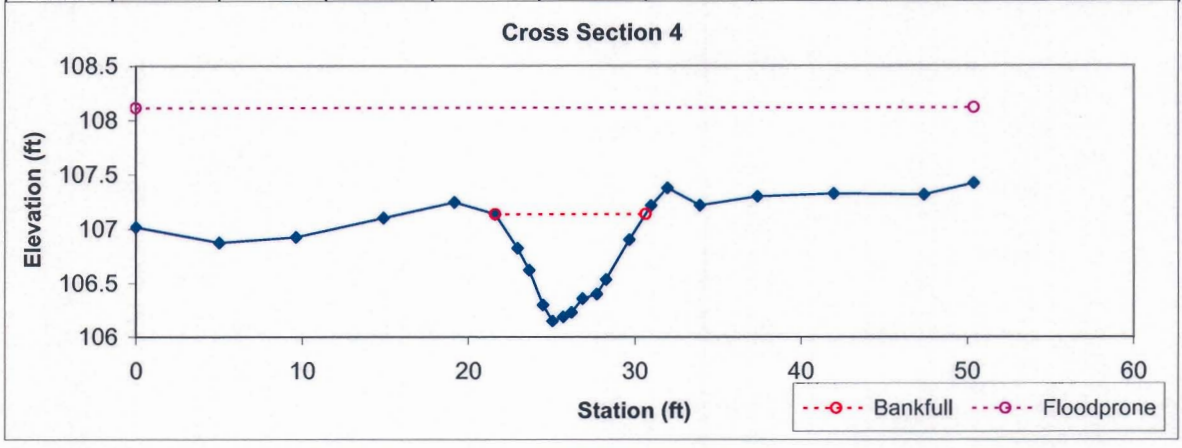
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	4.2	9.5	0.5	0.8	21.1	1.0	5.4	109.4	109.4



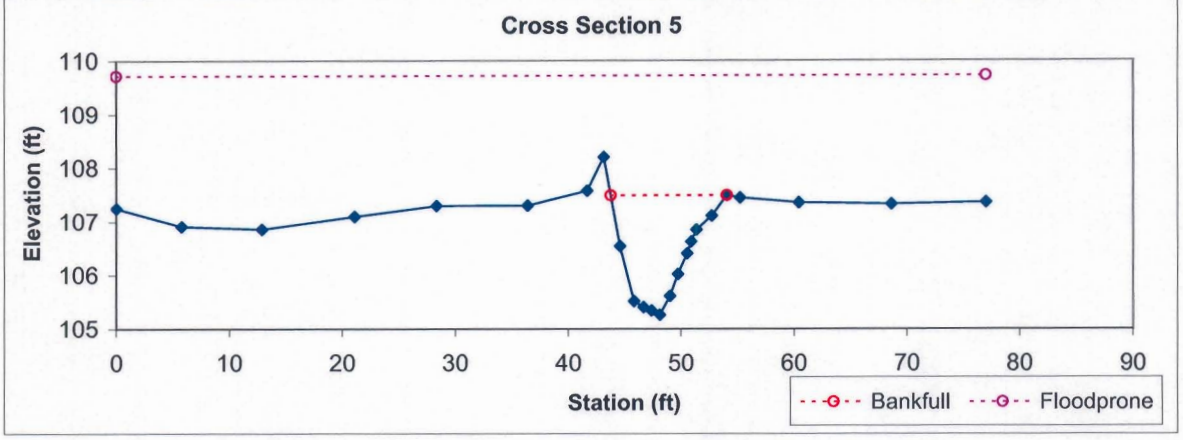
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		13.7	13.0	1.1	2.2	12.3	1.0	4.3	107.9	107.9



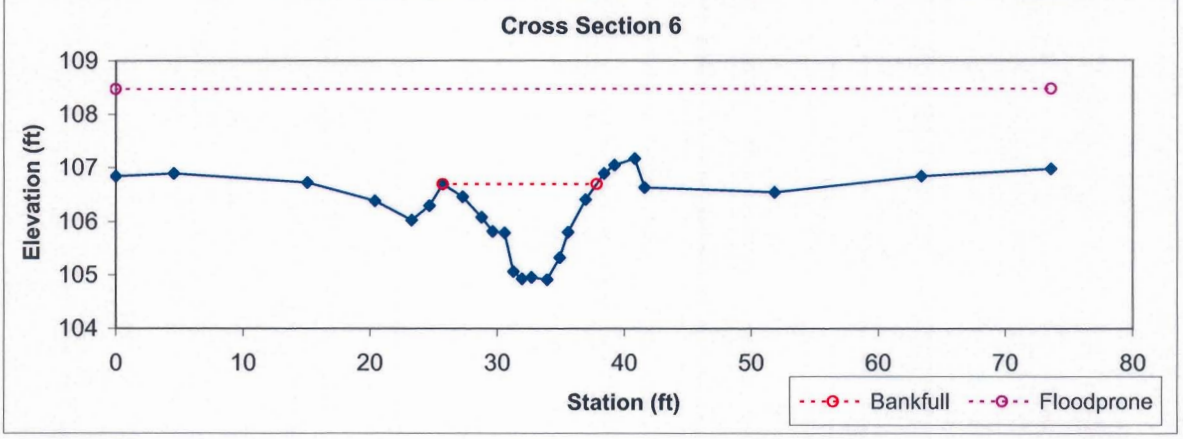
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	4.9	9.1	0.6	1.0	16.6	1.0	5.6	107.1	107.1



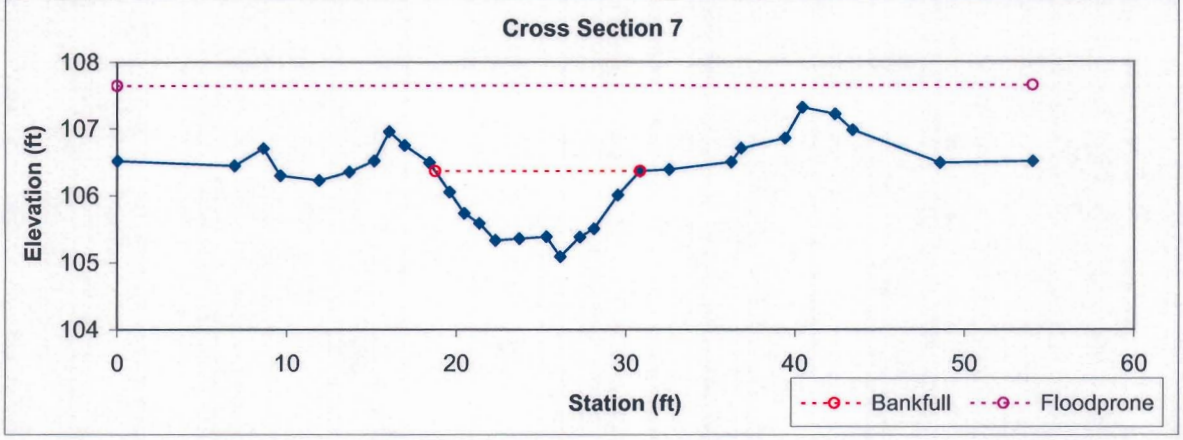
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		12.7	10.3	1.2	2.2	8.3	1.0	7.5	107.5	107.5



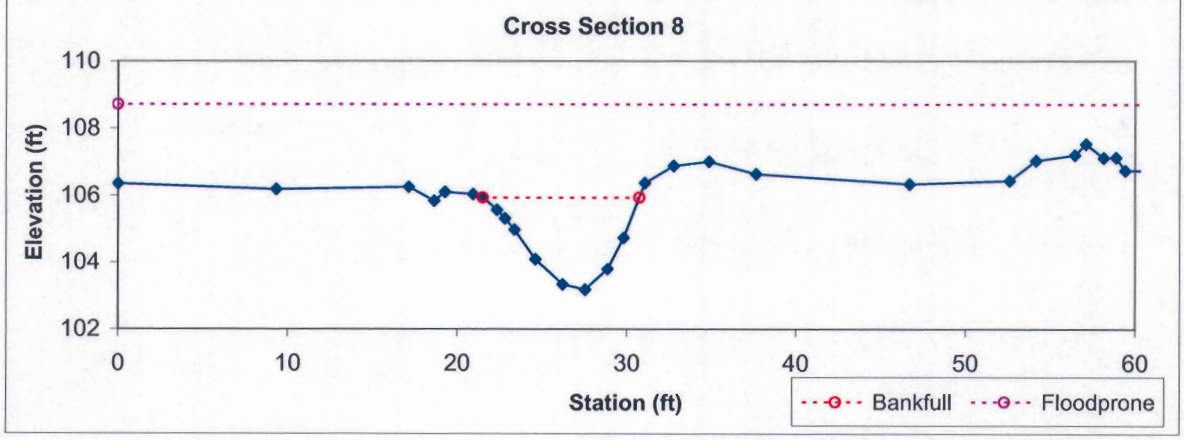
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		11.1	12.1	0.9	1.8	13.3	1.0	6.1	106.7	106.7



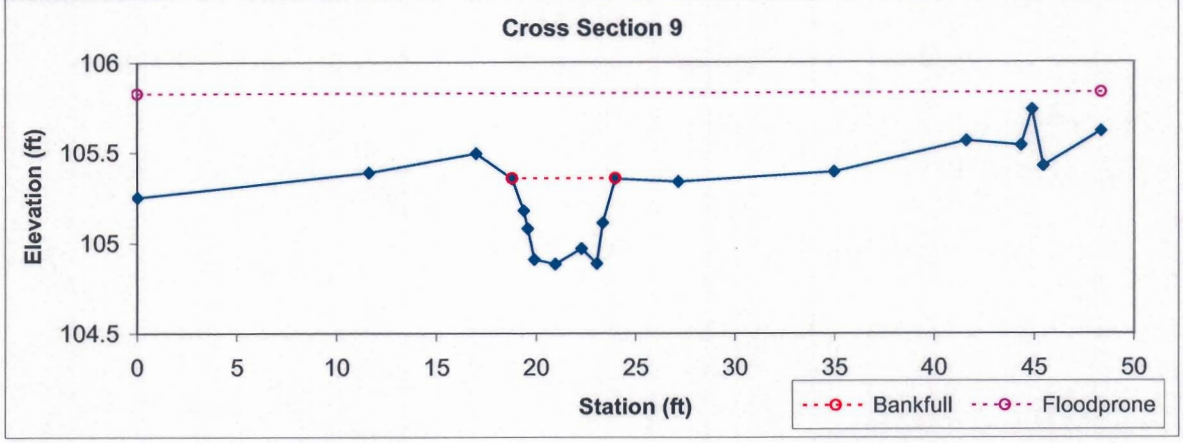
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	9.2	12.1	0.8	1.3	15.9	1.0	4.5	106.4	106.4



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		15.2	9.3	1.6	2.8	5.6	1.0	6.5	106.0	106.0



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	1.8	5.2	0.3	0.5	15.1	1.0	9.3	105.4	105.4



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
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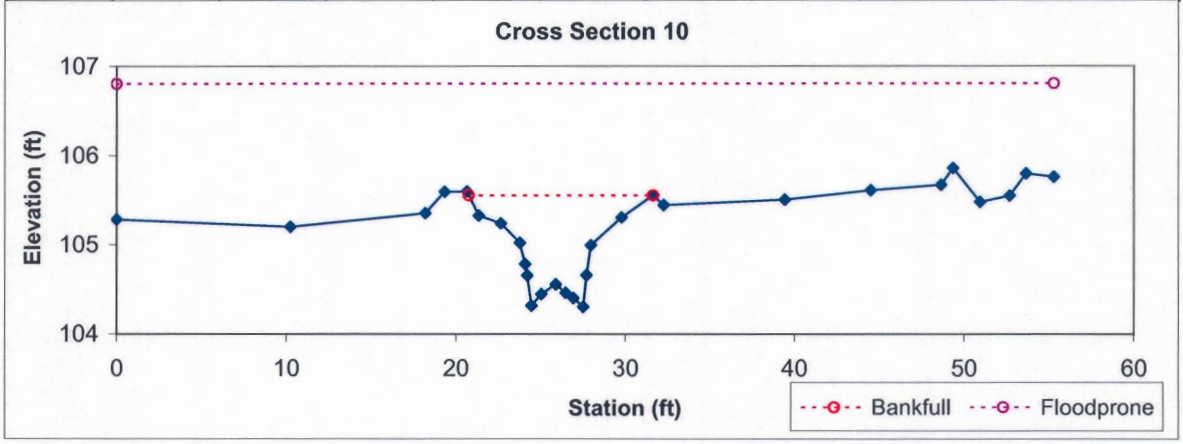
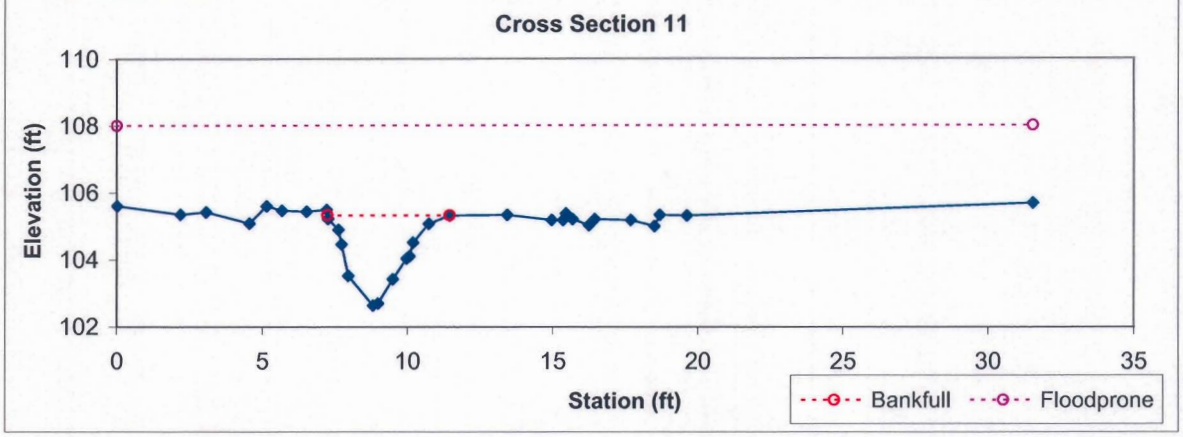
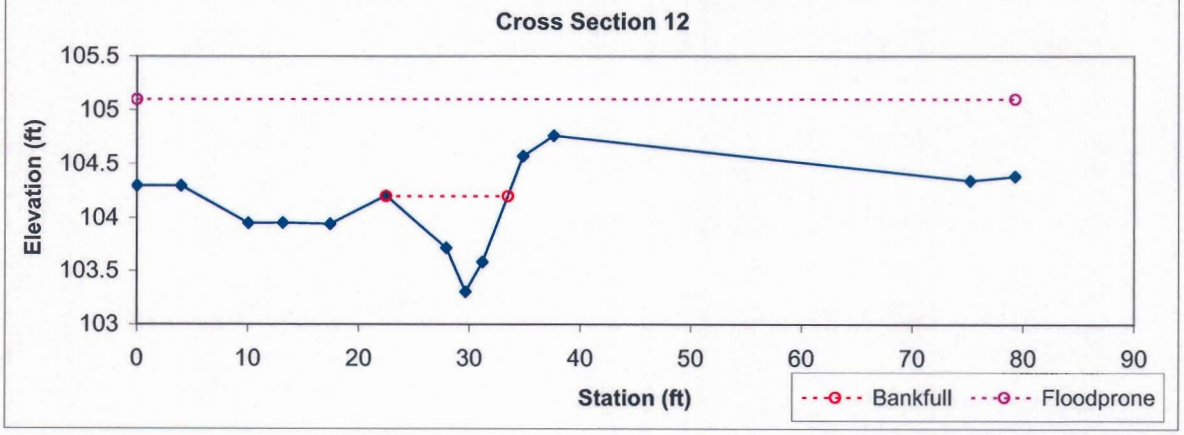


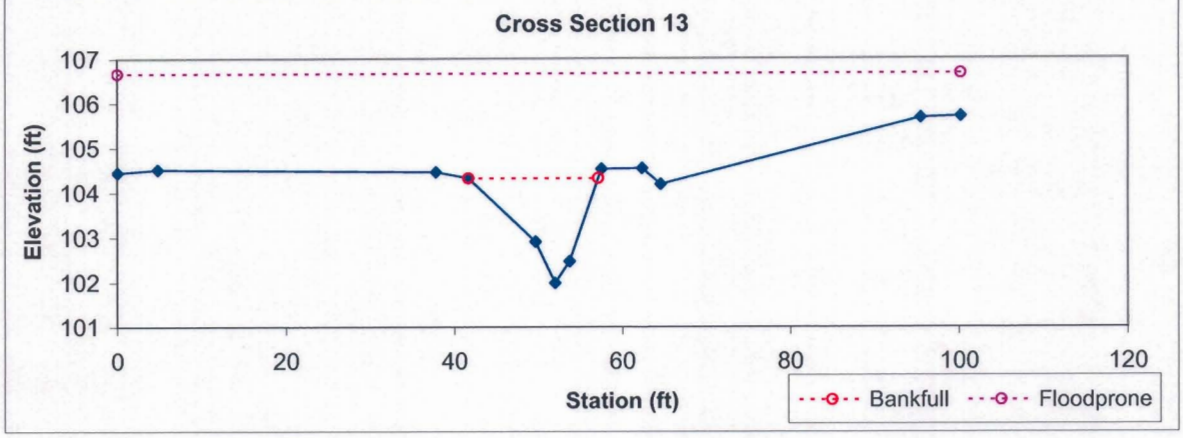
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		5.4	4.2	1.3	2.7	3.3	1.0	7.5	105.3	105.3



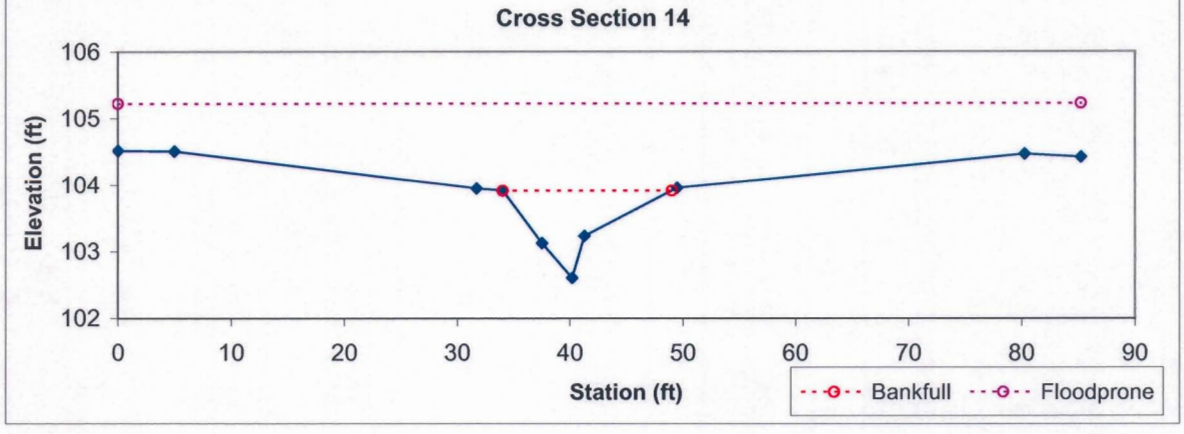
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	4.4	11.0	0.4	0.9	27.5	1.0	7.2	104.2	104.2



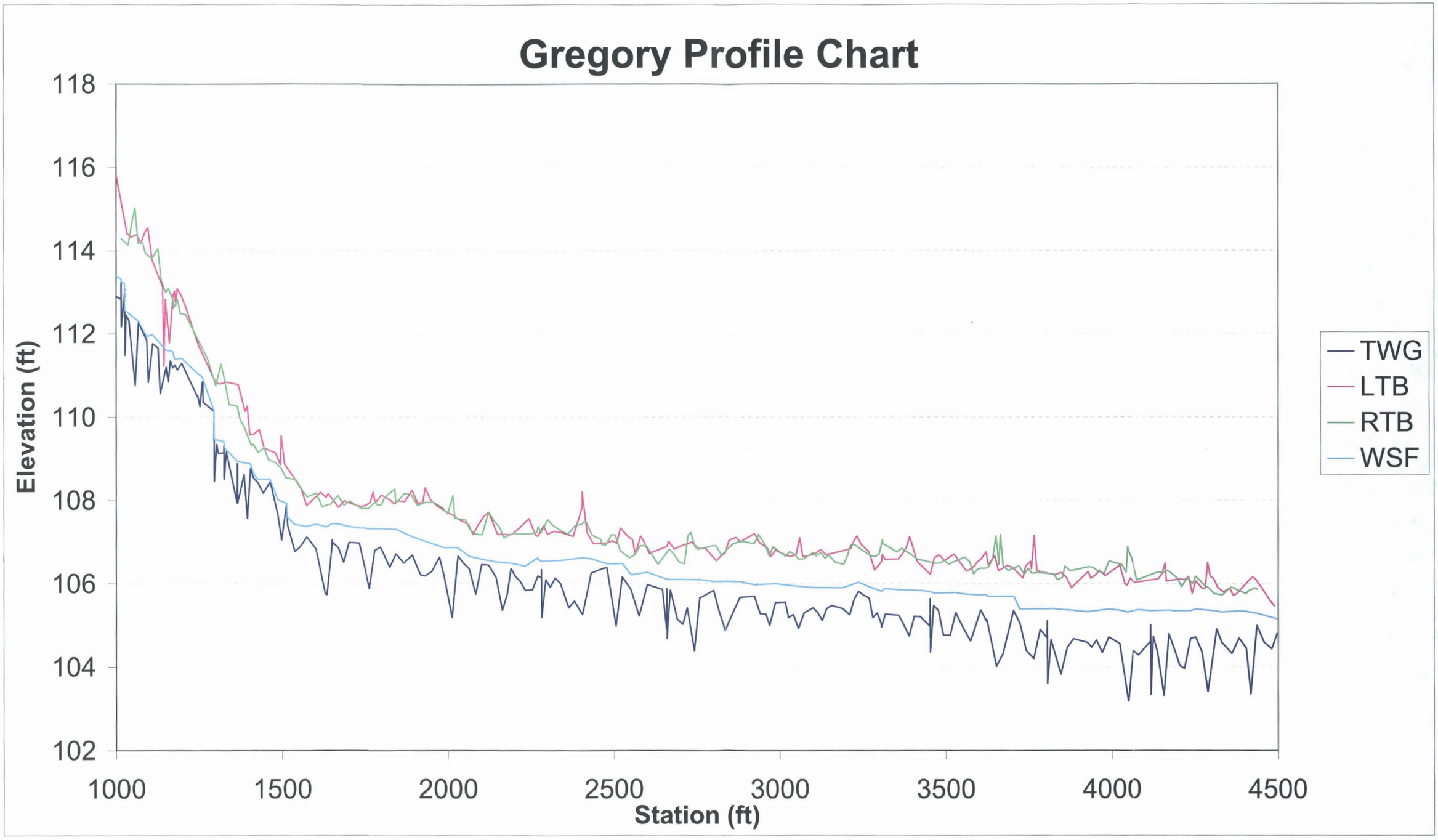
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16.8	15.4	1.1	2.3	14.2	1.0	6.5	104.3	104.3



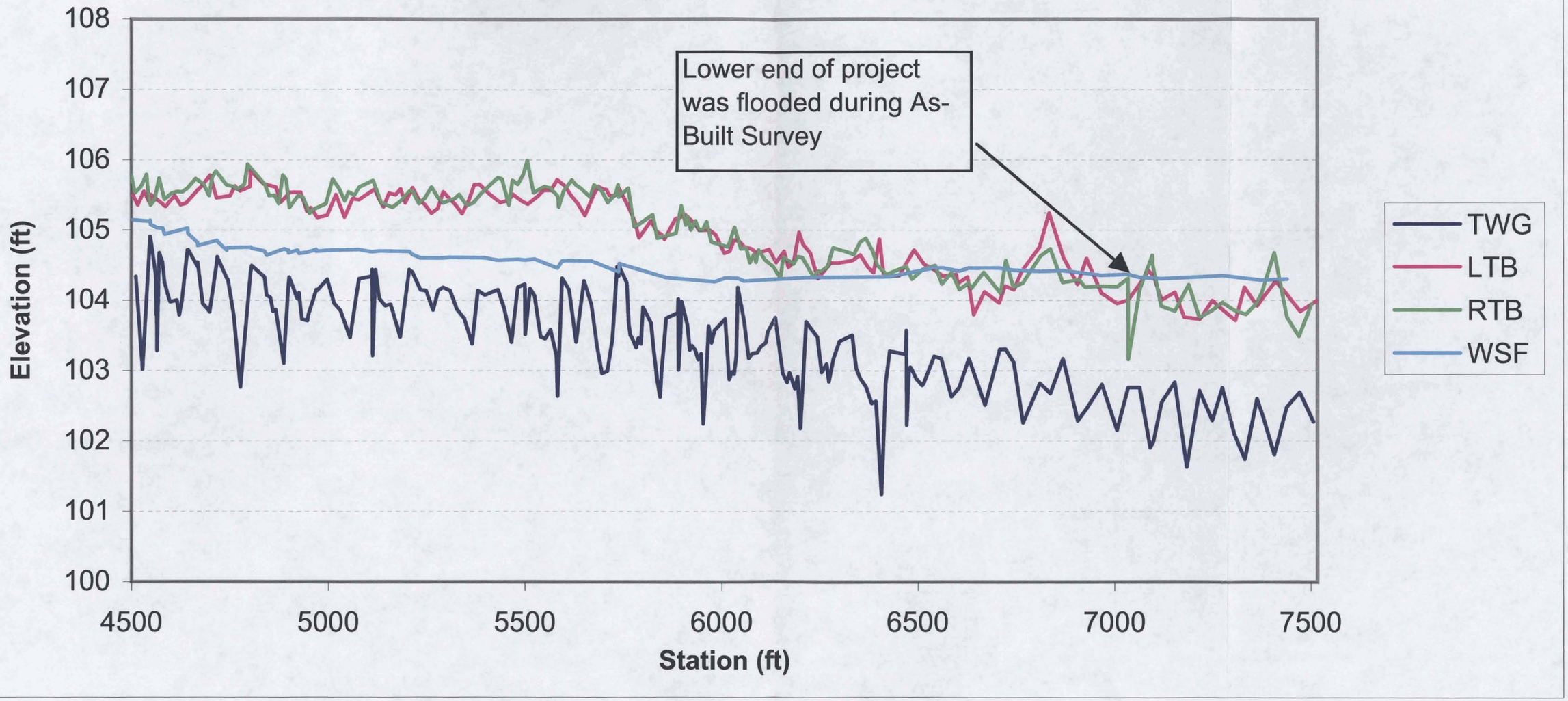
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	7.9	15.0	0.5	1.3	28.4	1.0	5.7	103.9	103.9



Gregory Profile Chart



Gregory Profile Chart



APPENDIX 3
AS-BUILT PLAN SHEETS

GREGORY SITE

PROJECT: 170

WETLAND & STREAM RESTORATION PROJECT
EBX NEUSE - I , LLC
GREGORY SITE

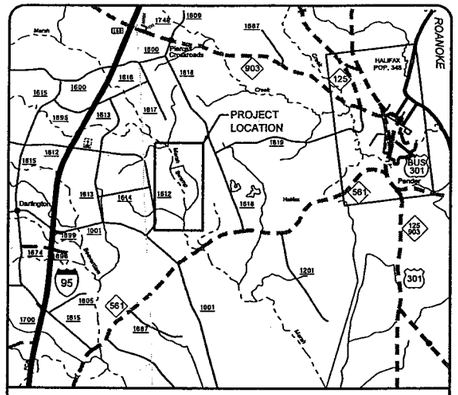
HALIFAX COUNTY

LOCATION: OFF NCSR 561 NEAR HALIFAX

TYPE OF WORK: AS-BUILT

STATE	PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	170	1	12

NO.	DATE	CHECKED BY	APPROVED BY
1	05/05/05	JOHN HUTTON	KEVIN TWEEDY
1	05/10/05	DANIEL TAYLOR	DANIEL TAYLOR



VICINITY MAP

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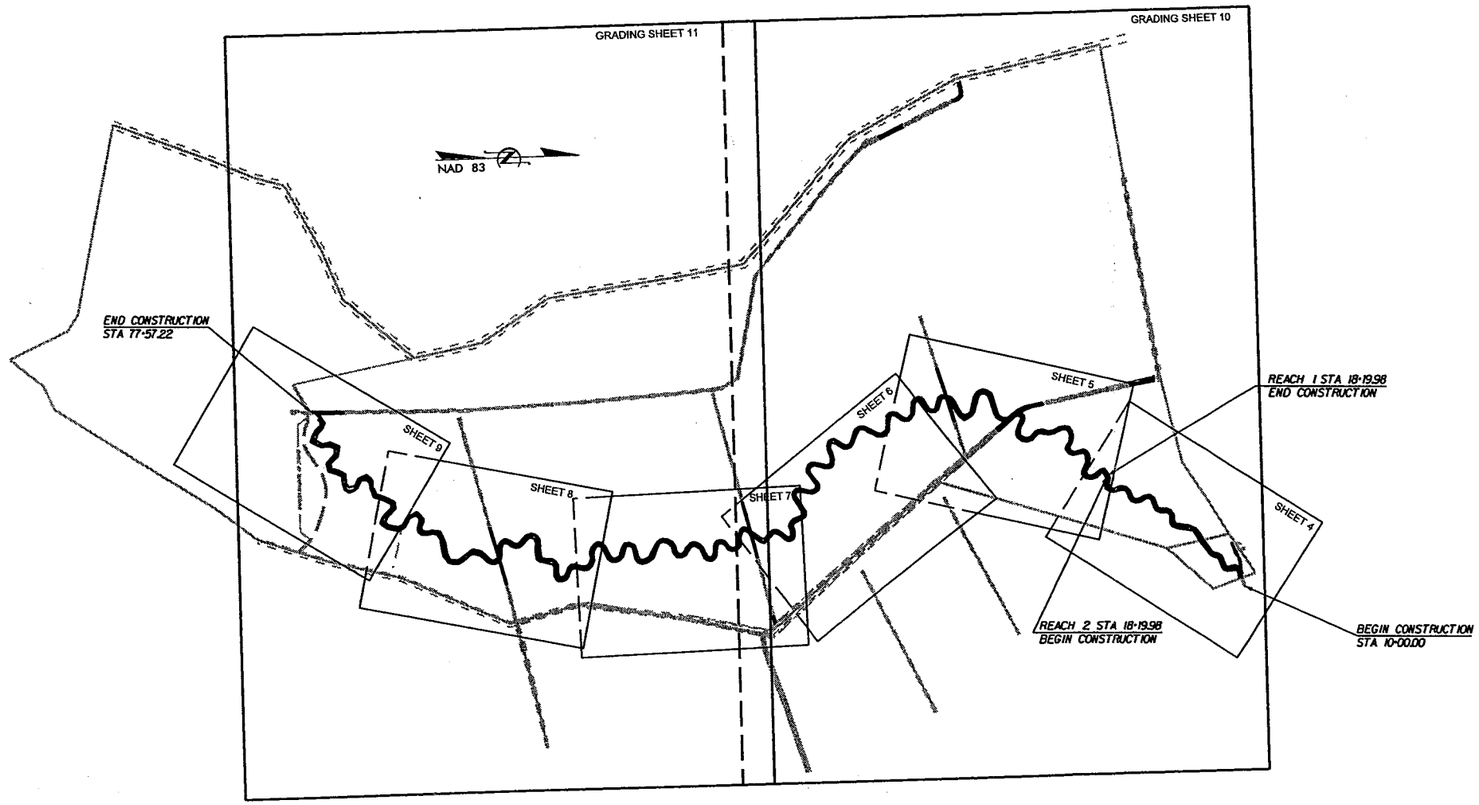
1-B ..... SYMBOLOGY - NCDOT
2 TO 2-B ..... STRUCTURE DETAILS
4 TO 9 ..... AS-BUILT PLANS VIEWS
10-11 ..... AS-BUILT GRADING PLANS



GRAPHIC SCALES

30 15 0 30 60

PLANS

PROJECT SUMMARY

AS-BUILT STREAM LENGTH = 6757 FEET

AS-BUILT RESTORED WETLAND = 85.8 AC

PREPARED FOR THE OFFICE OF:

EBX NEUSE - I , LLC

220 CHATHAM BUSINESS DRIVE
PITTSBORO, NC 27312

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TARA DISY ALLDEN
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PREPARED IN THE OFFICE OF:

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JAN. 2005
COMPLETION DATE:

JOHN HUTTON
PROJECT MANAGER

KEVIN TWEEDY, PE
PROJECT ENGINEER

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

5-24-05

SIGNATURE: P.E.

2/26/03

STREAM CONVENTIONAL SYMBOLS

SUPERCEDES SHEET 1B

LOG VANE

LOG WEIR

ROOT WAD

LOG CROSS VANE

J-HOOK

ROCK VANE

TEMPORARY SILT CHECK

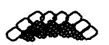
FOOT BRIDGE

TEMPORARY STREAM CROSSING

PERMANENT STREAM CROSSING

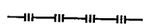
ROCK CROSS VANE

WING DEFLECTOR

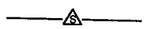


DOUBLE WING DEFLECTOR

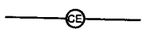
BOULDER CLUSTER



SILT FENCE



SAFETY FENCE



CONSERVATION EASEMENT

TRANSPLANTED VEGETATION

ROCK STEP POOL

TREE REMOVAL

TREE PROTECTION

PLAY GROUND EQUIPMENT

CONSTRUCTED RIFFLE

TRANSPLANTS

FILL EXISTING CHANNEL

CONTROL POINT

VEGETATION SELECTION

BARE ROOT/CONTAINERIZED VEGETATION			
NOTE: CONTAINERIZED AND BARE ROOT VEGETATION SHALL BE			
INSTALLED RANDOMLY AT A RATE OF 680/ACRE FROM THE TOP OF			
THE STREAMBANK OUT TO THE EDGE OF REVEGETATION LIMITS			
COMMON NAME	*SCIENTIFIC NAME*	QUANTITY	Percentages
WILLOW OAK	*QUERCUS PHELLOS*	9700	14.2
SWAMP CHESTNUT OAK	*QUERCUS MICHAUXII*	9700	14.2
LAUREL OAK	*QUERCUS LAURIFOLIA*	9700	14.2
OVERCUP OAK	*QUERCUS LYRATA*	9700	14.2
BLACKGUM	*NYSSA SYLVATICA*	9700	14.2
SWAMP BLACKGUM	*NYSSA BIFLORA*	4850	7.1
GREEN ASH	*FRAXINUS PENNSYLVANICA*	10000	14.7
BALD CYPRESS	*TAXODIUM DISTICHUM*	4850	7.1
	Total	68200	100.0
STREAMBANK PLANTING			
NOTE: LIVE STAKES SHALL BE INSTALLED RANDOMLY 2 TO 3 FEET APART ALONG			
THE STREAMBANKS FROM THE TOE OF THE BANK TO THE TOP OF BANK.			
COMMON NAME	*SCIENTIFIC NAME*		
BUTTONBUSH	*CEPHALANTHUS OCCIDENTALIS*		
SILKY WILLOW	*SALIX SERICEA*		
TEMPORARY SEED MIX			
NOTE: ALL DISTURBED AREAS WILL BE STABILIZED USING MULCH AND TEMPORARY SEED MIX			
COMMON NAME	RATE	PLANTING DATES	
ANNUAL RYE (COOL SEASON)	130 LBS/ACRE	SEPTEMBER TO MARCH	
MILLET (WARM SEASON)	45 LBS/ACRE	APRIL TO AUGUST	
RIPARIAN SEED MIX (PERMANENT)			
NOTE: RIPARIAN SEED MIX SHALL BE SEEDED AT A RATE OF			
½ LB PER 1000 FT² ALONG THE STREAMBANKS FROM THE			
TOE OF THE BANK TO THE TOP OF BANK.			
COMMON NAME	*SCIENTIFIC NAME*		
VIRGINIA WILDRYE	*ELYMUS VIRGINICUS*		
SWITCHGRASS	*PANICUM VIRGATUM*		
FOX SEDGE	*CAREX VULPINOIDEA*		
AMENDMENTS			
TYPE	RATE		
MULCHING	10 BALES PER 1000 FT²		

PROJECT REFERENCE NO.	SHEET NO.
170	1-A

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

APPROVED BY:

5-24-05

DATE:

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

STANDARD SPECIFICATIONS

EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL
DECEMBER 1993

6.60 TEMPORARY SEDIMENT TRAP

6.06 CONSTRUCTION ACCESS

6.62 SILT FENCE

6.70 TEMPORARY STREAM CROSSING (CULVERTED)

GENERAL NOTES

1. The Contractor is required to install instream structures using a track hoe with a hydraulic thumb of sufficient size to move boulders 3ft X 3ft X 2ft (approximately 2 tons).

2. The Contractor will be required to provide, at a minimum, two operators at all times during construction of the new stream channel. In general, one operator will cut the new channel with a track hoe, while the other operator follows and installs instream structures, bank stabilization practices, and transplants. During construction of the new stream channel, the contractor will be required to have two track hoes and one loader on-site.

3. Construction is scheduled to begin October 2004.

5/19/2005
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PROJECT REFERENCE NO.	SHEET NO.
170	1-B

*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

ROADS & RELATED ITEMS

Edge of Pavement
Curb
Prop. Slope Stakes Cut — C
Prop. Slope Stakes Fill — F
Prop. Woven Wire Fence
Prop. Chain Link Fence
Prop. Barbed Wire Fence
Prop. Wheelchair Ramp — WCR
Curb Cut for Future Wheelchair Ramp — CCFR
Exist. Guardrail
Prop. Guardrail
Equality Symbol
Pavement Removal

RIGHT OF WAY

Baseline Control Point
Existing Right of Way Marker
Exist. Right of Way Line w/Marker
Prop. Right of Way Line with Proposed R/W Marker
Prop. Right of Way Line with Proposed (Concrete or Granite) R/W Marker
Exist. Control of Access Line
Prop. Control of Access Line
Exist. Easement Line — E
Prop. Temp. Construction Easement Line — E
Prop. Temp. Drainage Easement Line — TDE
Prop. Perm. Drainage Easement Line — PDE

HYDROLOGY

Stream or Body of Water
River Basin Buffer — RBB
Flow Arrow
Disappearing Stream
Spring
Swamp Marsh
Shoreline
Falls, Rapids
Prop Lateral, Tail, Head Ditches — FLOW

STRUCTURES

MAJOR
Bridge, Tunnel, or Box Culvert — CONC
Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR
Head & End Wall — CONC HW
Pipe Culvert
Footbridge
Drainage Boxes — CB
Paved Ditch Gutter

UTILITIES

Exist. Pole
Exist. Power Pole
Prop. Power Pole
Exist. Telephone Pole
Prop. Telephone Pole
Exist. Joint Use Pole
Prop. Joint Use Pole
Telephone Pedestal — T
U/G Telephone Cable Hand Hold — HH
Cable TV Pedestal — C
U/G TV Cable Hand Hold — HH
U/G Power Cable Hand Hold — HH
Hydrant
Satellite Dish
Exist. Water Valve
Sewer Clean Out
Power Manhole
Telephone Booth — T
Cellular Telephone Tower
Water Manhole — W
Light Pole
H-Frame Pole
Power Line Tower
Pole with Base
Gas Valve
Gas Meter
Telephone Manhole — T
Power Transformer
Sanitary Sewer Manhole
Storm Sewer Manhole
Tank; Water, Gas, Oil — S
Water Tank With Legs
Traffic Signal Junction Box — S
Fiber Optic Splice Box — F
Television or Radio Tower
Utility Power Line Connects to Traffic Signal Lines Cut Into the Pavement — TS

Recorded Water Line — W
Designated Water Line (S.U.E.*) — W
Sanitary Sewer — SS
Recorded Sanitary Sewer Force Main — FSS
Designated Sanitary Sewer Force Main(S.U.E.*) — FSS
Recorded Gas Line — G
Designated Gas Line (S.U.E.*) — G
Storm Sewer — S
Recorded Power Line — P
Designated Power Line (S.U.E.*) — P
Recorded Telephone Cable — T
Designated Telephone Cable (S.U.E.*) — T
Recorded U/G Telephone Conduit — TC
Designated U/G Telephone Conduit (S.U.E.*) — TC
Unknown Utility (S.U.E.*) — SUTL
Recorded Television Cable — TV
Designated Television Cable (S.U.E.*) — TV
Recorded Fiber Optics Cable — FO
Designated Fiber Optics Cable (S.U.E.*) — FO
Exist. Water Meter — 0
U/G Test Hole (S.U.E.*) — ATTUR
Abandoned According to U/G Record — E.O.I.
End of Information

BOUNDARIES & PROPERTIES

State Line
County Line
Township Line
City Line
Reservation Line
Property Line
Property Line Symbol — PL
Exist. Iron Pin — EIP
Property Corner
Property Monument — CM
Property Number — 123
Parcel Number — 6
Fence Line — WW & ISBW
Existing Wetland Boundaries — WLB
High Quality Wetland Boundary — HQ WLB
Medium Quality Wetland Boundaries — MQ WLB
Low Quality Wetland Boundaries — LQ WLB
Proposed Wetland Boundaries — WLB
Existing Endangered Animal Boundaries — EAB
Existing Endangered Plant Boundaries — EPB

BUILDINGS & OTHER CULTURE

Buildings
Foundations
Area Outline
Gate
Gas Pump Vent or U/G Tank Cap
Church
School
Park
Cemetery
Dam
Sign
Well — W
Small Mine
Swimming Pool

TOPOGRAPHY

Loose Surface
Hard Surface
Change in Road Surface
Curb
Right of Way Symbol — R/W
Guard Post — GP
Paved Walk
Bridge
Box Culvert or Tunnel
Ferry
Culvert
Footbridge
Trail, Footpath
Light House

VEGETATION

Single Tree
Single Shrub
Hedge
Woods Line
Orchard
Vineyard — VINEYARD

RAILROADS

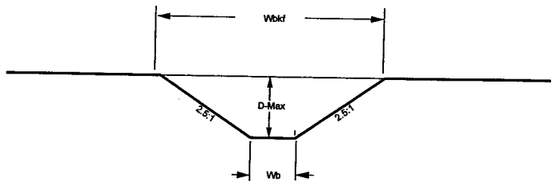
Standard Gauge — CSX TRANSPORTATION
RR Signal Milepost — MILEPOST 35
Switch — SWITCH

revised 02/02/00

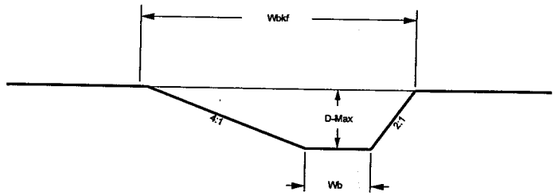
2/26/03

TYPICAL RIFFLE AND POOL FOR REACH 1 AND 2

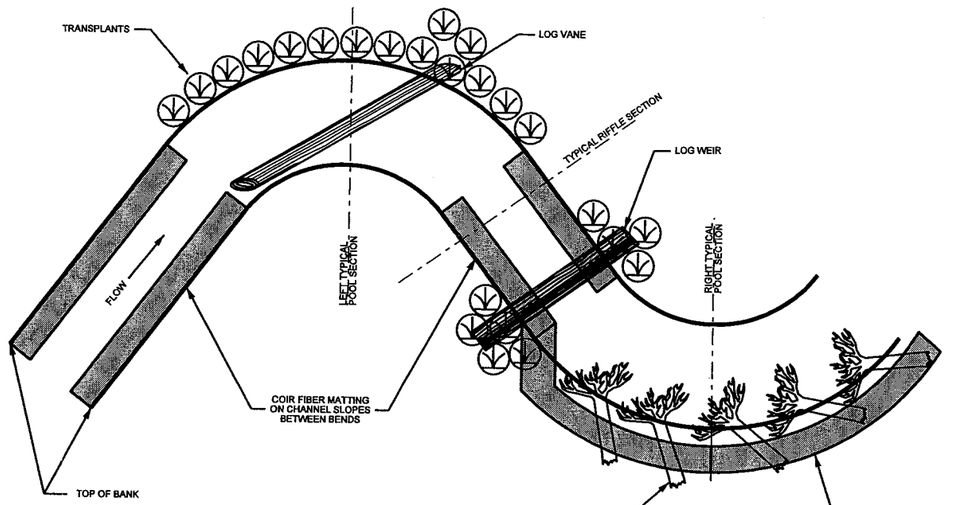
RIFFLE



POOL



REACH 1		REACH 2		
RIFFLE	POOL	RIFFLE	POOL	
7.3'	8.9'	9.2'	11.9'	WIDTH OF BANKFULL (Wbkf)
0.6'	0.7'	0.7'	0.9'	AVERAGE DEPTH
0.9'	1.3'	0.9'	1.5'	MAXIMUM DEPTH (D-max)
12.0	12.2	14.0	13.1	WIDTH TO DEPTH RATIO (bkfl W/D)
4.5ft²	6.5ft²	6.0ft²	10.8ft²	BANKFULL AREA (Abkf)
3.0'	1.1'	4.9'	3.5'	BOTTOM WIDTH (Wb)



GENERALLY LOG WEIRS, ROOT WADS, LOG VANES, MATTING AND TRANSPLANTS WILL BE INSTALLED IN THE LOCATIONS AND SEQUENCE AS SHOWN. ADDITIONAL STRUCTURES OR CHANGES TO STRUCTURE LOCATIONS MAY BE MADE BY THE ENGINEER DURING CONSTRUCTION.

PROJECT REFERENCE NO.	SHEET NO.
170	2

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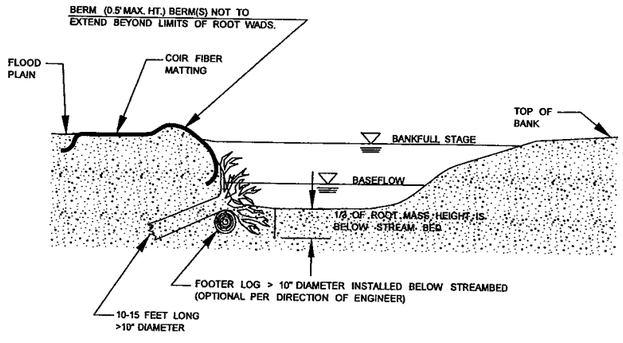
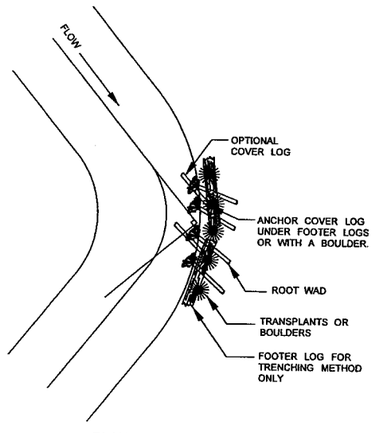
ROOT WADS WITHOUT TRANSPLANTS

NTS



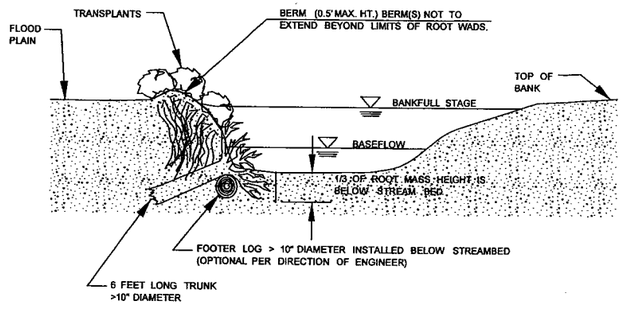
CROSS SECTION VIEW



PLAN VIEW

ROOT WADS WITH TRANSPLANTS

NTS



CROSS SECTION VIEW

NOTES:

TRENCHING METHOD:
IF THE ROOT WAD CANNOT BE DRIVEN INTO THE BANK OR THE BANK NEEDS TO BE RECONSTRUCTED, THE TRENCHING METHOD SHOULD BE USED. THIS METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. IN THIS CASE, A FOOTER LOG SHOULD BE INSTALLED UNDERNEATH THE ROOT WAD IN A TRENCH EXCAVATED PARALLEL TO THE BANK AND WELL BELOW THE STREAMBED. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.

NOTES:

DRIVE POINT METHOD:
SHARPEN THE END OF THE LOG WITH A CHAINSAW BEFORE "DRIVING" IT INTO THE BANK. ORIENT ROOT WADS UPSTREAM SO THAT THE STREAM FLOW MEETS THE ROOT WAD AT A 90-DEGREE ANGLE, DEFLECTING THE WATER AWAY FROM THE BANK. A TRANSPLANT OR BOULDER SHOULD BE PLACED ON THE DOWNSTREAM SIDE OF THE ROOT WAD IF A BACK EDDY IS FORMED BY THE ROOT WAD. THE BOULDER SHALL BE APPROXIMATELY 4'X 3'X 2'.

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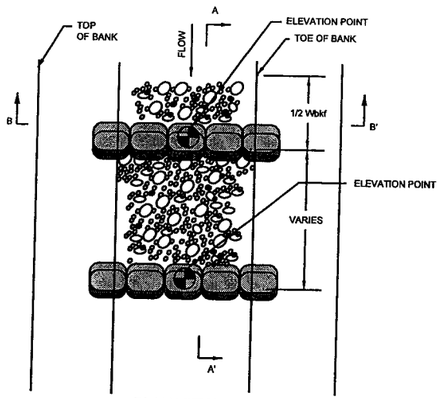
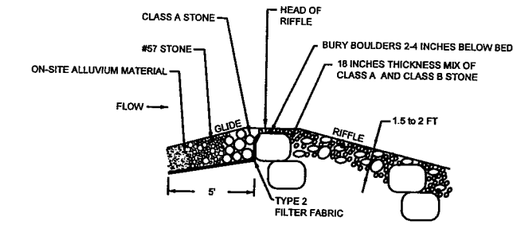
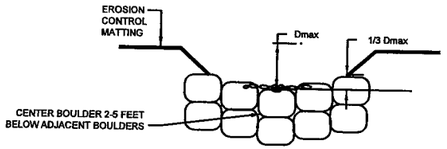
CONSTRUCTED RIFFLE



PLAN VIEW



PROFILE A-A'



SECTION B-B'

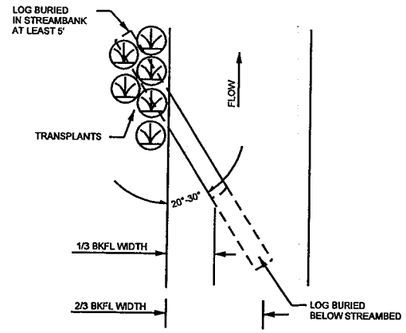
NOTES:

1. BOULDERS MUST BE AT LEAST 3' x 3' x 2'.
2. INSTALL FILTER FABRIC FOR DRAINAGE BEGINNING AT THE MIDDLE OF THE HEADER ROCKS AND EXTEND DOWNWARD TO THE DEPTH OF THE BOTTOM FOOTER ROCK, AND THEN UPSTREAM TO A MINIMUM OF FIVE FEET.
3. DIG A TRENCH BELOW THE BED FOR FOOTER ROCKS AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBED.
4. START AT BANK AND PLACE FOOTER ROCKS FIRST AND THEN HEADER (TOP) ROCK.
5. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
6. USE CLASS A STONE TO FILL GAPS ON UPSTREAM SIDE OF BOULDERS AND #57 STONE TO FILL GAPS ON UPSTREAM SIDE OF CLASS A STONE.
7. AFTER ALL STONE HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER ROCK.

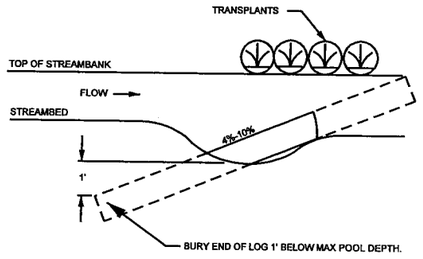
	GREGORY SITE	
	REACH 1	REACH 2
Wbkf (ft)	7.3	10.3
Dmax (ft)	0.9	1.0

CONSTRUCTED RIFFLE #	HEAD OF RIFFLE	ELEVATION	TAIL OF RIFFLE	ELEVATION
1	11+03.42	112.06	11+14.86	111.71
2	11+98.34	111.03	12+14.59	110.76
3	12+96.44	109.80	13+30.09	109.45
4	14+37.85	108.44	14+54.13	108.04
5	14+93.10	107.85	15+09.42	107.50
6	15+45.46	107.34	15+62.72	106.82
7	16+11.00	106.61	16+27.39	106.54
8	17+39.84	106.49	17+56.36	106.30

LOG VANE



PLAN VIEW

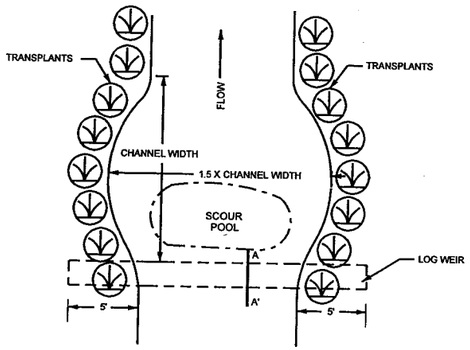


PROFILE VIEW

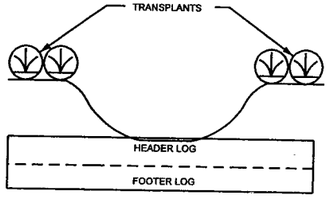
NOTES:

1. LOGS SHOULD BE AT LEAST 12" INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. TRANSPLANTS ARE PLACED ALONG THE TOP OF THE BANK OVER THE BURIED LOG VANE TO PROTECT AGAINST EROSION DURING HIGH FLOWS.

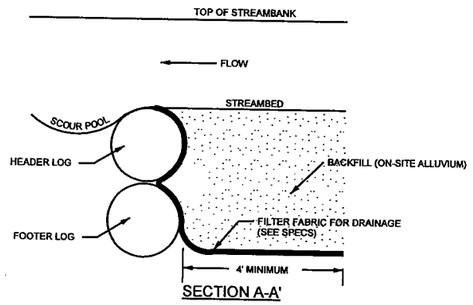
LOG WEIR



PLAN VIEW



CROSS SECTION VIEW

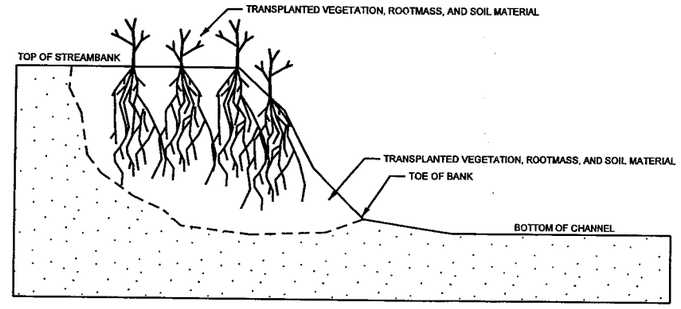


SECTION A-A'

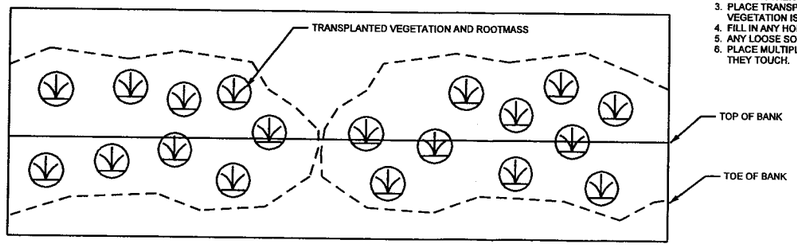
NOTES:

1. LOGS SHOULD BE AT LEAST 10 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS >20 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG. FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG
3. TOP OF HEADER LOG SHOULD BE SET AT SAME ELEVATION AS THE STREAMBED.
4. USE FILTER FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
5. PLACE TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.

TRANSPLANTED VEGETATION



CROSS SECTION VIEW



PLAN VIEW

NOTES:

1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE TRANSPLANT USING A FRONT END LOADER. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATE IN ONE BUCKET LOAD, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLACE TRANSPLANT IN THE BANK TO BE STABILIZED SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

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170	2-A

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5-24-05

DATE:

BUCK ENGINEERING

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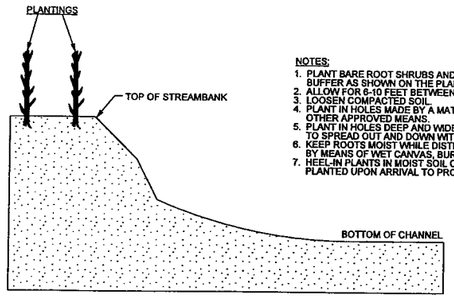
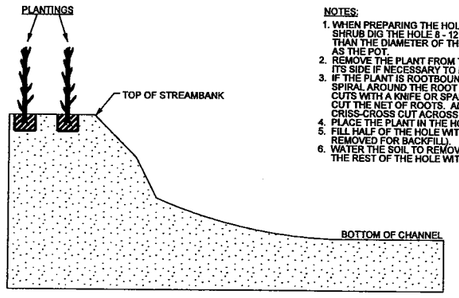
2/26/03

PLANTING SPECIFICATIONS



CROSS SECTION VIEW OF BARE ROOT PLANTING

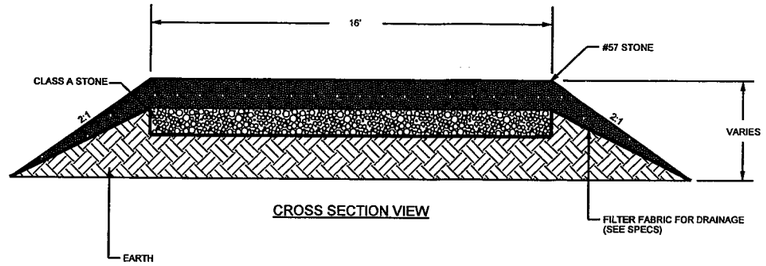
NOTES:
1. PLANT BARE ROOT SHRUBS AND TREES TO THE WIDTH OF THE BUFFER AS SHOWN ON THE PLANS.
2. ALLOW FOR 6-10 FEET BETWEEN PLANTINGS, DEPENDING ON SIZE.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR, OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP, OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO PROJECT SITE.



CROSS SECTION VIEW OF CONTAINER PLANTING

NOTES:
1. WHEN PREPARING THE HOLE FOR A POTTED PLANT OR SHRUB DIG THE HOLE 8 - 12 INCHES LARGER THAN THE DIAMETER OF THE POT AND THE SAME DEPTH AS THE POT.
2. REMOVE THE PLANT FROM THE POT. LAY THE PLANT ON ITS SIDE IF NECESSARY TO REMOVE THE POT.
3. IF THE PLANT IS ROOTBOUND (ROOTS GROWING IN A SPIRAL AROUND THE ROOT BALL), MAKE VERTICAL CUTS WITH A KNIFE OR SPADE JUST DEEP ENOUGH TO CUT THE NET OF ROOTS. ALSO MAKE A CRISS-CROSS CUT ACROSS THE BOTTOM OF THE BALL.
4. PLACE THE PLANT IN THE HOLE.
5. FILL HALF OF THE HOLE WITH SOIL (SAME SOIL REMOVED FOR BACKFILL).
6. WATER THE SOIL TO REMOVE AIR POCKETS AND FILL THE REST OF THE HOLE WITH THE REMAINING SOIL.

CATTLE PATH



CROSS SECTION VIEW

NOTES:
PLACE 6 INCHES OF #57 STONE ON TOP OF 6 INCHES OF CLASS A STONE THEN SLOPE BANKS AT A 2:1 SLOPE.

PROJECT REFERENCE NO.	SHEET NO.
170	2-B

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

APPROVED BY:

5-24-05

DATE:

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Cary, North Carolina 27511
Phone: 919-463-5488
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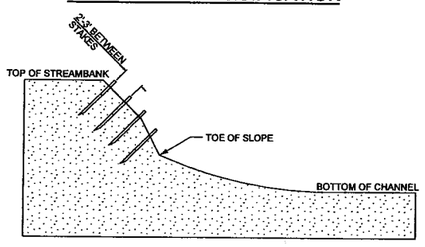
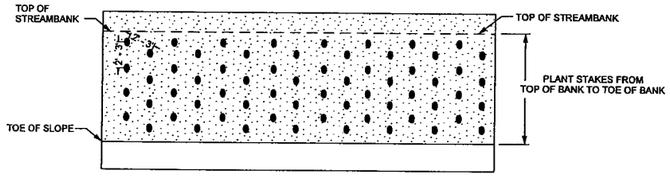
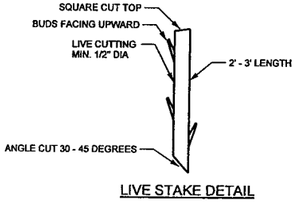
LIVE STAKING SPECIFICATION



CROSS SECTION VIEW



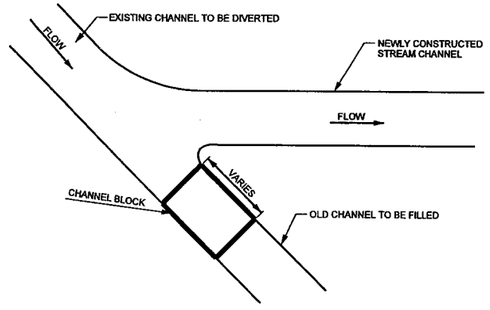
PLAN VIEW



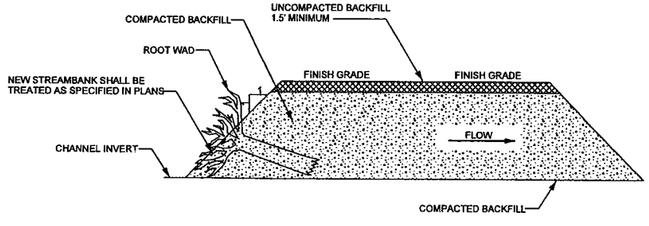
LIVE STAKE DETAIL

NOTES:
1. STAKES SHOULD BE CUT AND INSTALLED ON THE SAME DAY.
2. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
3. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
4. STAKES SHOULD BE INSTALLED PERPENDICULAR TO BANK.
5. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT LONG.
6. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.

CHANNEL BLOCK

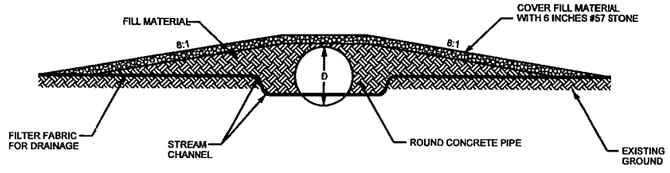


PLAN VIEW

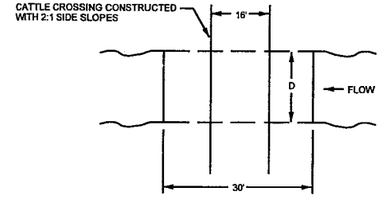


PROFILE VIEW

PERMANENT STREAM CROSSING



CROSS SECTION VIEW



PLAN VIEW

5/19/2005
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PROJECT REFERENCE NO.	SHEET NO.
170	4

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L TWEEDY

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5-24-05

DATE:

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Phone: 919-463-5488
Fax: 919-463-5490

REACH 1 STA 10+00.00
BEGIN CONSTRUCTION

PROPERTY BOUNDARY

46" RCP

ADJACENT LANDOWNER EASEMENT

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

18+00

X-SECTION 1

X-SECTION 2

X-SECTION 3

PERMANENT STREAM CROSSING

REACH 2 STA 18+19.98
BEGIN CONSTRUCTION

REACH 1 STA 18+19.98
END CONSTRUCTION

MATCHLINE SHEET 5 STA 18+38.00

NAD 83

FILLED CHANNEL AREA

CHANNEL BLOCK

GREGORY SITE
AS-BUILT

30 15 0 30 60
SCALE (FT)

2/26/03

5/18/2005
S:\8170R\Design\Plans\8170R_EBX_psh_AB_04.dgn

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
170	5

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN I. TWEEDY

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5-24-05

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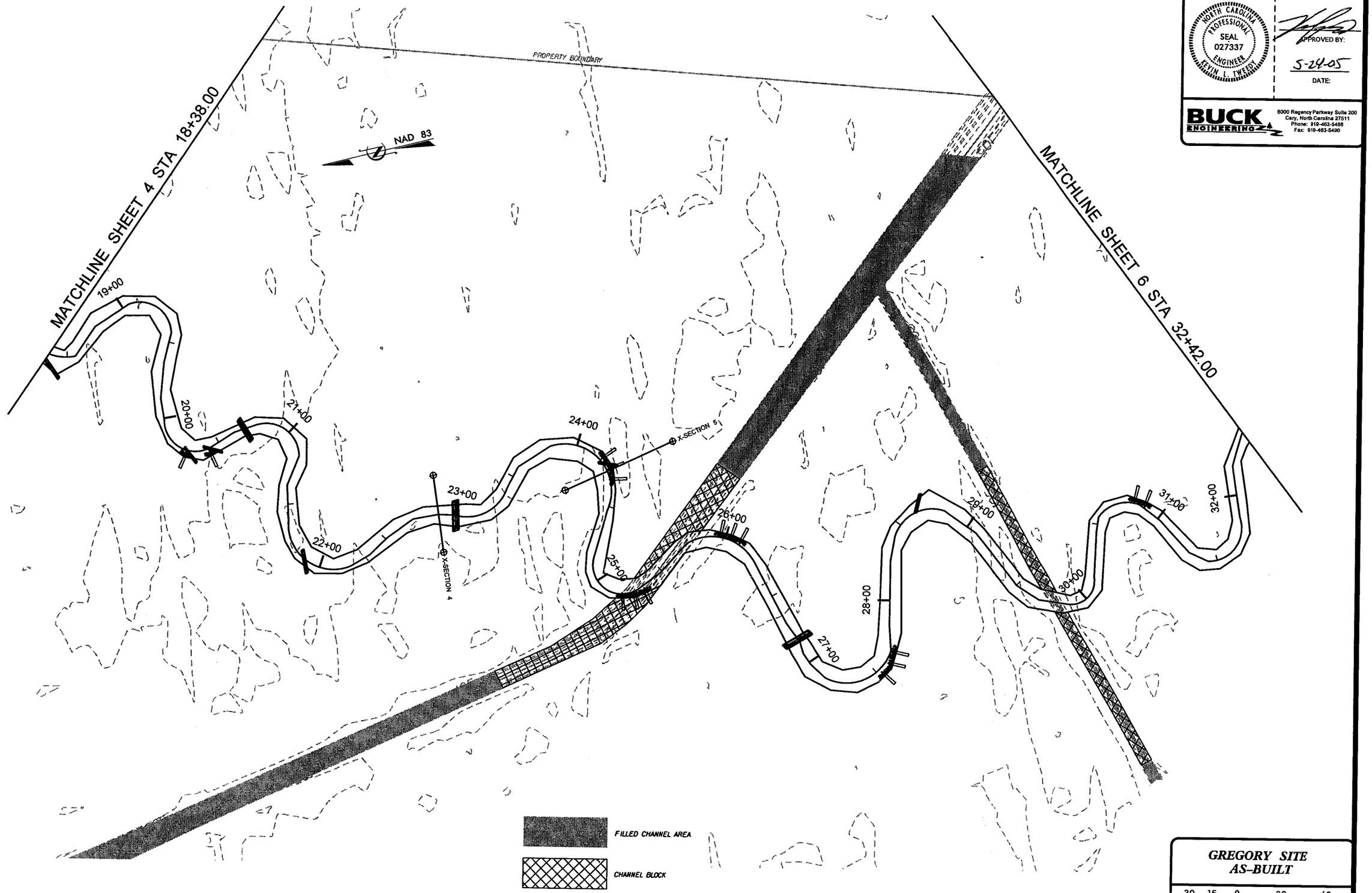

GREGORY SITE
AS-BUILT

30 15 0 30 60
SCALE (FT)

5/19/2005
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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
170	6

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

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5-24-05

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Fax: 919-463-5490

NAD 83

MATCHLINE SHEET 5 STA 32+42.00

MATCHLINE SHEET 7 STA 44+69.00

McCOLLUCH'S DITCH / PROPERTY BOUNDARY

105

105

105

105

105

105

105

50'

50'

50'

X-SECTION 6

X-SECTION 7

X-SECTION 8

33+00

34+00

35+00

36+00

37+00

38+00

39+00

40+00

41+00

42+00

43+00

44+00

FILLED CHANNEL AREA

CHANNEL BLOCK

GREGORY SITE
AS-BUILT

30 15 0 30 60
SCALE (FT)

5/19/2005
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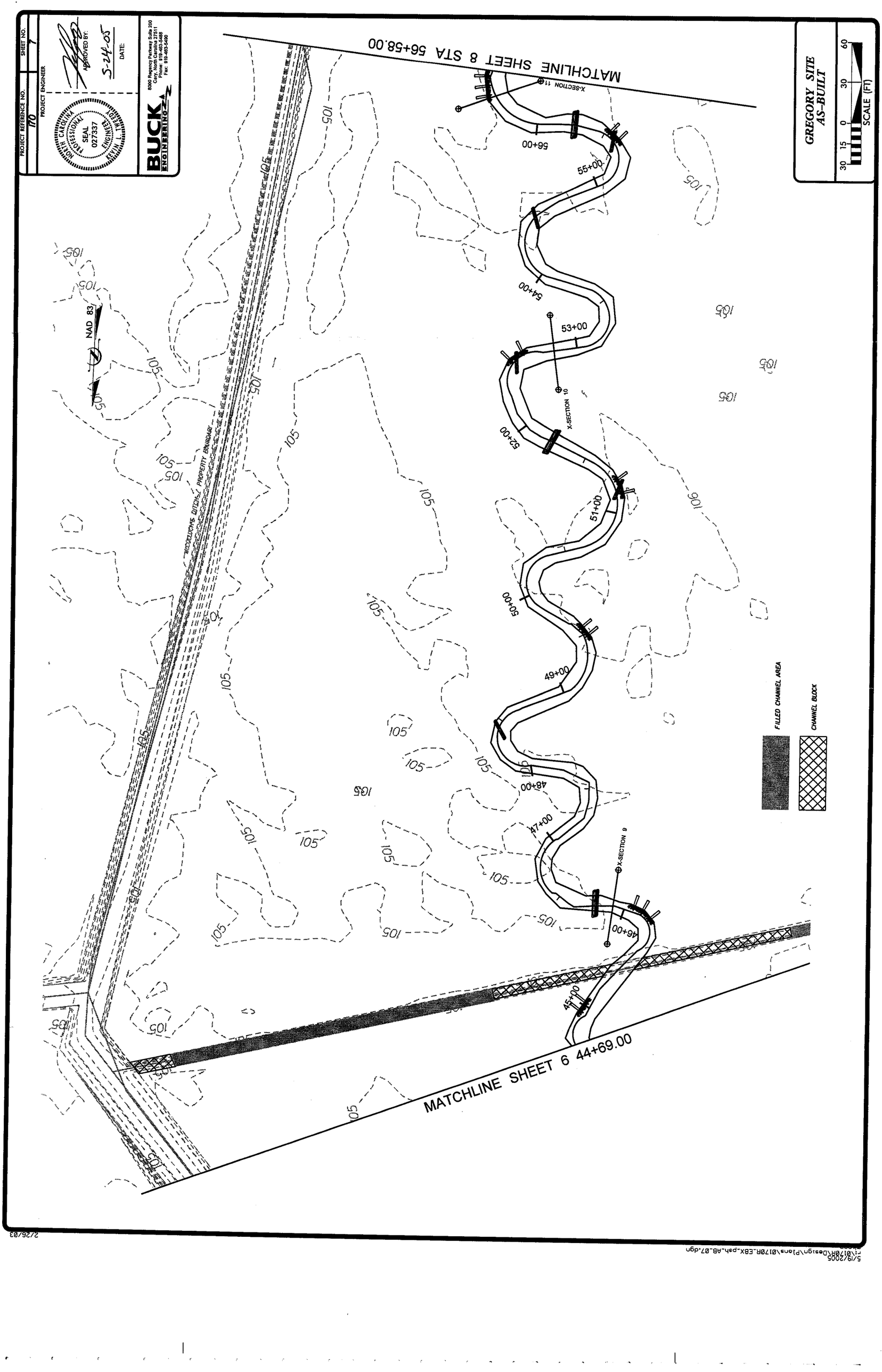

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2/28/03

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
170	8

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

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5-24-05

DATE:

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Phone: 919-463-5488
Fax: 919-463-5490

NAD 83

PROPERTY BOUNDARY

MATCHLINE SHEET 7 STA 56+58.00

MATCHLINE SHEET 9 STA 68+77.00

57+00 58+00 59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00 68+00

X-SECTION 12

FILLED CHANNEL AREA

CHANNEL BLOCK

GREGORY SITE AS-BUILT

30 15 0 30 60
SCALE (FT)

5/19/2005
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2/25/03

PROJECT REFERENCE NO.	SHEET NO.
170	9

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEED

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5-24-05

DATE:

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Fax: 919-463-5490

MATCHLINE SHEET 8 STA 68+77.00

69+00

70+00

71+00

X-SECTION 13

72+00

73+00

74+00

X-SECTION 14

75+00

76+00

77+00

REACH 2 STA 77+57.22
END CONSTRUCTION

NAD 83

FILLED CHANNEL AREA

CHANNEL BLOCK

GREGORY SITE
AS-BUILT

30 15 0 30 60
SCALE (FT)

5/19/2005
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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
170	10

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEDT

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Phone: 919-463-5488
Fax: 919-463-5490

NAD 83

PROPERTY BOUNDARY

CONSTRUCTED BERM

AS-BUILT WETLAND RESTORATION BOUNDARY

GRADING LIMITS

AUTOMATIC MONITORING WELL #1

AUTOMATIC MONITORING WELL #2

AUTOMATIC MONITORING WELL #5

AUTOMATIC MONITORING WELL #7

MANUAL MONITORING WELL #3

MANUAL MONITORING WELL #4

MANUAL MONITORING WELL #6

VEGETATION MONITORING PLOT WETLAND 1

VEGETATION MONITORING PLOT WETLAND 2

VEGETATION MONITORING PLOT WETLAND 3

VEGETATION MONITORING PLOT STREAM 1

CREST GAGE #1

RAIN GAGE #1

REACH 1 STA 10+00.00 BEGIN CONSTRUCTION

REACH 1 STA 18+19.98 END CONSTRUCTION

REACH 2 STA 18+19.98 BEGIN CONSTRUCTION

MATCHLINE SHEET 11

AS-BUILT WETLAND AREA

CHANNEL BLOCK

FILLED CHANNEL AREA

NOTE:
AS-BUILT CONTOURS ARE ACCURATE TO WITHIN +/- 5 INCHES

GREGORY SITE AS-BUILT PLANS

100 50 0 100 200
SCALE (FT)

5/26/2005
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2/26/03

MATCHLINE SHEET 10

PROJECT REFERENCE NO.	SHEET NO.
170	11

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEED

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Fax: 919-463-5490

NAD 83

VEGETATION MONITORING PLOT STREAM 2

AUTOMATIC MONITORING WELL #9

CREST GAGE

AUTOMATIC MONITORING WELL #8

CONSTRUCTED BERM

AS-BUILT WETLAND RESTORATION BOUNDARY

GRADING LIMITS

VEGETATION MONITORING PLOT STREAM 3

VEGETATION MONITORING PLOT WETLAND 4

AUTOMATIC MONITORING WELL #10

MANUAL MONITORING WELL #11

AS-BUILT WETLAND RESTORATION BOUNDARY

EXTENT OF EXISTING WETLAND

REACH 2 STA 77+67.23 END CONSTRUCTION

AS-BUILT WETLAND AREA

FILLED CHANNEL AREA

CHANNEL BLOCK

NOTE:
AS-BUILT CONTOURS ARE ACCURATE TO WITHIN +/- 5 INCHES

GREGORY SITE
AS-BUILT PLANS

100 50 0 100 200
SCALE (FT)

5/24/2005
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